# Enlightening the Technology Gap for Safety: Work as Done vs. Work as Imagined

**Salman Nazir**

Training & Assessment Research Group (TARG)

Department of Maritime Operations
University of South-Eastern Norway

University of South-Eastern Norway

TARG
TRAINING AND ASSESSMENT RESEARCH GROUP

MARKOM 2020
DEVELOPS MARITIME COMPETENCE TOWARD

# 9th Workshop participants

- 10+ Nationalities
- 10 Universities
- 4 Industries
- Norwegian Coastal Administration

# TARG team

University of South-Eastern Norway

TARG
TRAINING AND ASSESSMENT RESEARCH GROUP

# WHAT DO WE DO?

Our Aim is to Improve Human Performance within Modern Complex Systems

## TRAINING

- SIMULATOR TRAINING
- MARITIME EDUCATION
- RESOURCE MANAGEMENT

## ASSESSMENT

- MARITIME INDICATORS
- OPERATOR ASSESSMENT
- ASSESSMENT METHODS

## HUMAN ELEMENTS

- MARITIME TEAMWORK
- HUMAN ERROR
- HUMAN-MACHINE INTERACTION

## SAFETY

- ACCIDENT ANALYSIS
- SAFETY TRAINING
- SAFETY MANAGEMENT

## AUTONOMY

- FUTURE SKILLS
- TRAINING NEEDS
- IMPLEMENTATION AID

# TARG Projects

## InnoTraining

- Innovating maritime training simulators using Virtual and Augmented Reality
- 13M NOK
- 2017-2021

The Research Council of Norway

## AUTOSTRIP

- Autonomous Systems within Transport and Industrial Processes
- 30M NOK
- 2018-2023

The Research Council of Norway

## Training Needs

- Investigating Seafarer Training Needs for Operating Autonomous Ships
- 0.6 MNOK
- 2018 - 2019

IAMU International Association of Maritime Universities

## HUMANE

- Human Maritime Autonomy Enable
- 12M NOK
- 2018 - 2021

The Research Council of Norway

## ENHANCE

- Enhancing Human Performance in Complex Socio-Technical Systems
- 11 M NOK
- 2018-2022

HORIZON 2020

## Workshops

- Joint Workshops
- 3.5 M NOK
- 2014 - 2019

MARKOM 2020 DEVELOPS MARITIME COMPETENCE TOWARD 2020

# The Maritime industry

# Speakers and panelists

Anne Kari Botnmark

Charlott Sellberg

Christen Vagle

Gesa Praetorius

Jarle Løwe Sørensen

Kjetil Nordby

Kristine Vedal Størkersen

Margareta Holtensdotter Lützhöft

Marina

Paal Aamaas

Risza Rusli

Steffen Hårstad Jensen

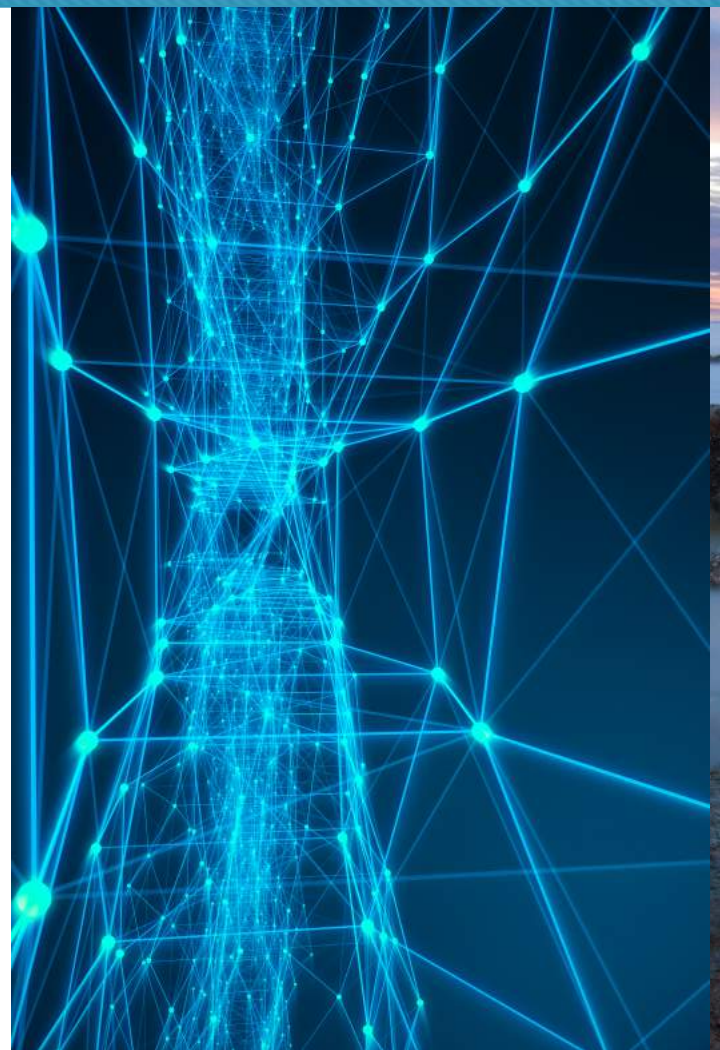
Steven C. Mallam

Salman Nazir

Zaili Yang

# Challenges

- Maritime accidents
- Complexity of new technologies
- Teaching and assessment methods
- Future demands



# 4th Combined Workshop on Training and Assessment, Denmark (2016)

“Profit vs Safety”

# 5th Combined Workshop on Training and Assessment, Horten (2016)

“Strengthening Norwegian Maritime Education, Training and Safety with National and International Cooperation”

# 6th Combined Workshop on Training and Assessment, Tromsø (2017)

“The Role of Autonomy in Maritime Education, Training and Safety with National and International Cooperation”

# Work originating from 6th Workshop

## TARG Presents at IEA 2018

Home / TARG Presents at IEA 2018

During the last week of August TARG member Steven Mallam attended the 20th Congress of the International Ergonomics Association (IEA 2018) in Florence, Italy.

Two papers were presented, which cover key areas of TARG's research scope: autonomous shipping and virtual reality in seafarer training (see full reference information below).

The IEA Congress is a triannual gathering of Human Factors and Ergonomics researchers, practitioners and members of international federated societies, providing a fruitful and diverse environment for learning and networking.

TARG looks forward to contribute to IEA 2021!

# TARG IEA 2018 articles

- Mallam S. C., Nazir S., Renganayagalu S. K., Ernstsen J., Veie S. & Edwinson A. E. (2019). Design of Experiment Comparing Users of Virtual Reality Head-Mounted Displays and Desktop Computers. In: Bagnara S., Tartaglia R., Albolino S., Alexander T., Fujita Y. (eds). *Proceedings of the 20th Congress of the International Ergonomics Association* (IEA 2018). IEA 2018. Advances in Intelligent Systems and Computing, vol 822, pp. 240-249. Springer, Cham. DOI: 10.1007/978-3-319-96077-7_25

- Mallam S. C., Nazir S., Sharma A. & Veie S. (2019). Perspectives on Autonomy – Exploring Future Applications and Implications for Safety Critical Domains. In: Bagnara S., Tartaglia R., Albolino S., Alexander T., Fujita Y. (eds). *Proceedings of the 20th Congress of the International Ergonomics Association* (IEA 2018). IEA 2018. Advances in Intelligent Systems and Computing, vol 82, pp. 396-405. Springer, Cham. DOI: 10.1007/978-3-319-96080-7_47

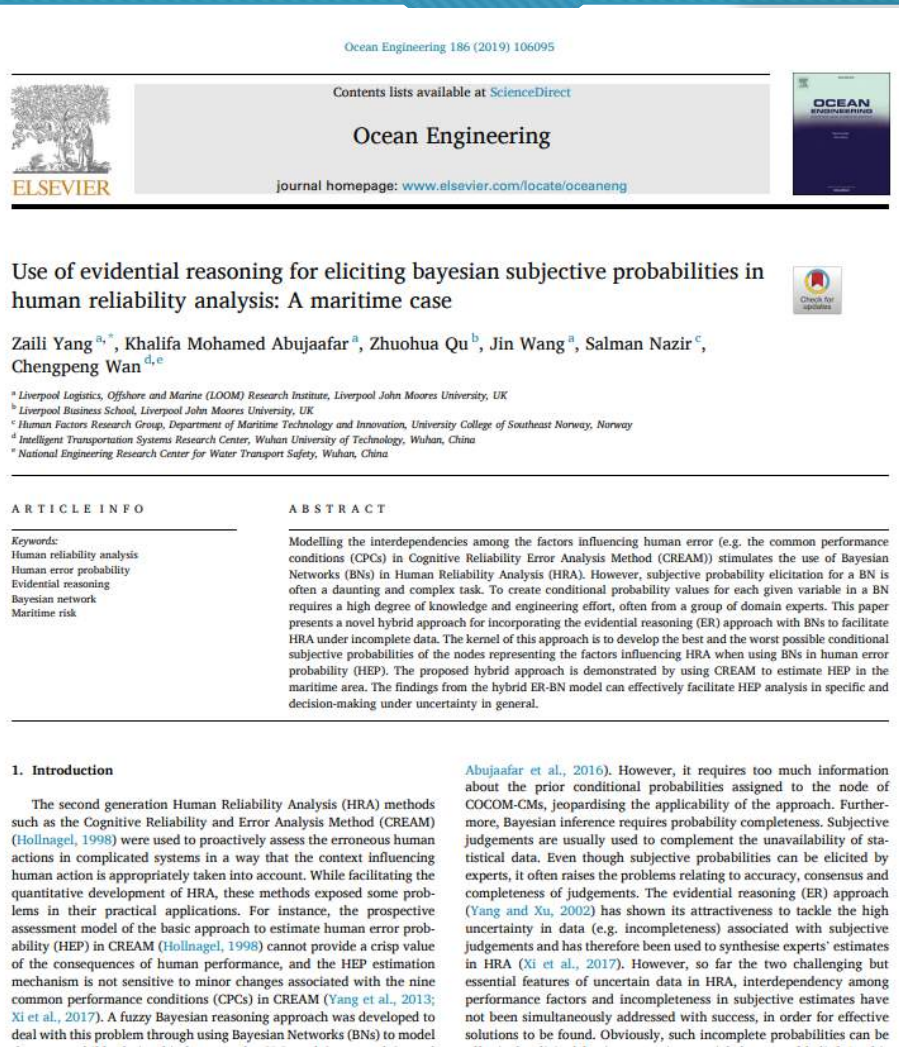
# 7th Combined Workshop on Training and Assessment, Ålesund (2018)

“Improving Simulator Training and Performance Assessment”

# 8th Combined Workshop on Training and Assessment, Tønsberg (2018)

“Collaborative Training, Education and Operations”

# Research



Ocean Engineering 186 (2019) 106095

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journal homepage: www.elsevier.com/locate/oceaneng

## Use of evidential reasoning for eliciting bayesian subjective probabilities in human reliability analysis: A maritime case

Zaili Yang [a,*], Khalifa Mohamed Abujaafar [a], Zhuohua Qu [b], Jin Wang [a], Salman Nazir [c], Chengpeng Wan [d,e]

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[b] Liverpool Business School, Liverpool John Moores University, UK
[c] Human Factors Research Group, Department of Maritime Technology and Innovation, University College of Southeast Norway, Norway
[d] Intelligent Transportation Systems Research Center, Wuhan University of Technology, Wuhan, China
[e] National Engineering Research Center for Water Transport Safety, Wuhan, China

ARTICLE INFO

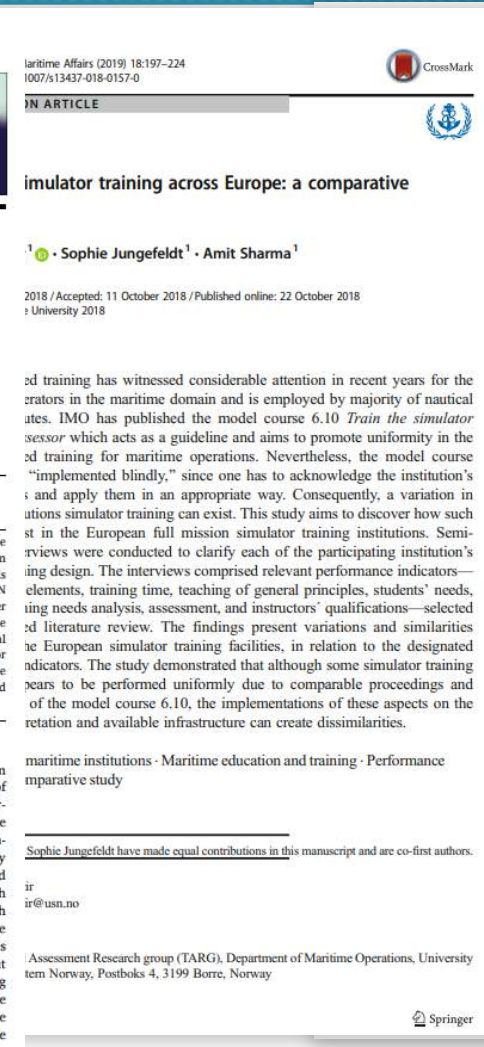
*Keywords:*
Human reliability analysis
Human error probability
Evidential reasoning
Bayesian network
Maritime risk

ABSTRACT

Modelling the interdependencies among the factors influencing human error (e.g. the common performance conditions (CPCs) in Cognitive Reliability Error Analysis Method (CREAM)) stimulates the use of Bayesian Networks (BNs) in Human Reliability Analysis (HRA). However, subjective probability elicitation for a BN is often a daunting and complex task. To create conditional probability values for each given variable in a BN requires a high degree of knowledge and engineering effort, often from a group of domain experts. This paper presents a novel hybrid approach for incorporating the evidential reasoning (ER) approach with BNs to facilitate HRA under incomplete data. The kernel of this approach is to develop the best and the worst possible conditional subjective probabilities of the nodes representing the factors influencing HRA when using BNs in human error probability (HEP). The proposed hybrid approach is demonstrated by using CREAM to estimate HEP in the maritime area. The findings from the hybrid ER-BN model can effectively facilitate HEP analysis in specific and decision-making under uncertainty in general.

### 1. Introduction

The second generation Human Reliability Analysis (HRA) methods such as the Cognitive Reliability and Error Analysis Method (CREAM) (Hollnagel, 1998) were used to proactively assess the erroneous human actions in complicated systems in a way that the context influencing human action is appropriately taken into account. While facilitating the quantitative development of HRA, these methods exposed some problems in their practical applications. For instance, the prospective assessment model of the basic approach to estimate human error probability (HEP) in CREAM (Hollnagel, 1998) cannot provide a crisp value of the consequences of human performance, and the HEP estimation mechanism is not sensitive to minor changes associated with the nine common performance conditions (CPCs) in CREAM (Yang et al., 2013; Xi et al., 2017). A fuzzy Bayesian reasoning approach was developed to deal with this problem through using Bayesian Networks (BNs) to model Abujaafar et al., 2016). However, it requires too much information about the prior conditional probabilities assigned to the node of COCOM-CMs, jeopardising the applicability of the approach. Furthermore, Bayesian inference requires probability completeness. Subjective judgements are usually used to complement the unavailability of statistical data. Even though subjective probabilities can be elicited by experts, it often raises the problems relating to accuracy, consensus and completeness of judgements. The evidential reasoning (ER) approach (Yang and Xu, 2002) has shown its attractiveness to tackle the high uncertainty in data (e.g. incompleteness) associated with subjective judgements and has therefore been used to synthesise experts' estimates in HRA (Xi et al., 2017). However, so far the two challenging but essential features of uncertain data in HRA, interdependency among performance factors and incompleteness in subjective estimates have not been simultaneously addressed with success, in order for effective solutions to be found. Obviously, such incomplete probabilities can be



laritime Affairs (2019) 18:197–224
l007/s13437-018-0157-0

ON ARTICLE

imulator training across Europe: a comparative

· Sophie Jungefeldt [1] · Amit Sharma [1]

2018 / Accepted: 11 October 2018 / Published online: 22 October 2018
University 2018

ed training has witnessed considerable attention in recent years for the erators in the maritime domain and is employed by majority of nautical utes. IMO has published the model course 6.10 *Train the simulator sessor* which acts as a guideline and aims to promote uniformity in the ed training for maritime operations. Nevertheless, the model course "implemented blindly," since one has to acknowledge the institution's and apply them in an appropriate way. Consequently, a variation in utions simulator training can exist. This study aims to discover how such st in the European full mission simulator training institutions. Semi-rviews were conducted to clarify each of the participating institution's ing design. The interviews comprised relevant performance indicators—elements, training time, teaching of general principles, students' needs, ing needs analysis, assessment, and instructors' qualifications—selected ed literature review. The findings present variations and similarities he European simulator training facilities, in relation to the designated ndicators. The study demonstrated that although some simulator training pears to be performed uniformly due to comparable proceedings and of the model course 6.10, the implementations of these aspects on the retation and available infrastructure can create dissimilarities.

maritime institutions · Maritime education and training · Performance mparative study

Sophie Jungefeldt have made equal contributions in this manuscript and are co-first authors.

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evelopment of performance
in the maritime domain

Nazir [1]

pted: 22 January 2018 / Published online: 14 February 2018

stry is considered to be a backbone of the global economy. ensure that maritime operations run safely and efficiently. formance is necessary for designers and engineers to be links in the system and make impactful system improve-resents a systematic quantitative literature review of re-sment in the maritime industry with the goal of establish-racy and consistency in the development of methods used review focuses on four major segments within the indus-lling, safety and environmental research—and investigates curate and consistent performance assessment methods. exclusion process, 62 articles published in a wide range ed in the analysis. Two important conclusions were drawn ormance assessment is generally consistent throughout the rs used accurate and consistent approaches to develop the nt bivariate analysis revealed a call for increased attention ssment methods within the maritime segment of ship suggests and discusses certain directions with regard to aritime industry.

nance · Assessment · Performance indicators · Literature

earch Group, Department of Maritime Operations, University College Norway

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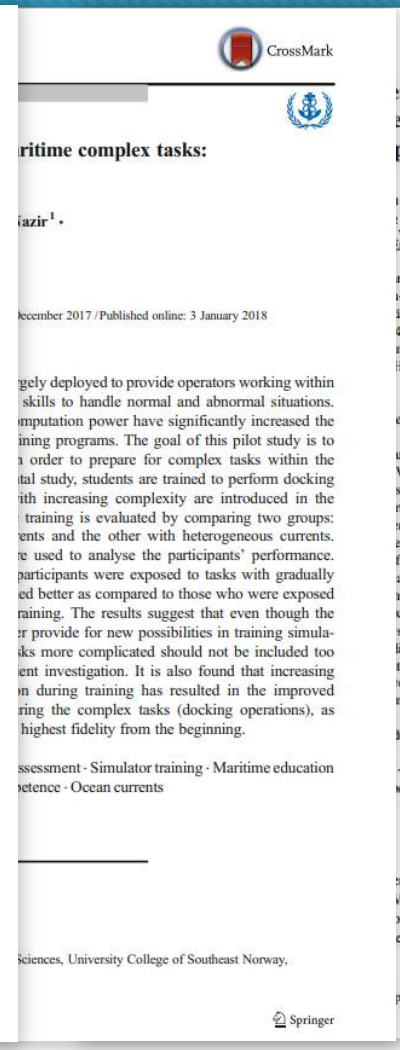

ritime complex tasks:

Jazir [1] ·

ecember 2017 / Published online: 3 January 2018

gely deployed to provide operators working within skills to handle normal and abnormal situations. mputation power have significantly increased the ining programs. The goal of this pilot study is to n order to prepare for complex tasks within the tal study, students are trained to perform docking ith increasing complexity are introduced in the training is evaluated by comparing two groups: ents and the other with heterogeneous currents. e used to analyse the participants' performance. participants were exposed to tasks with gradually ed better as compared to those who were exposed raining. The results suggest that even though the r provide for new possibilities in training simula-ks more complicated should not be included too ent investigation. It is also found that increasing n during training has resulted in the improved ring the complex tasks (docking operations), as highest fidelity from the beginning.

ssessment · Simulator training · Maritime education petence · Ocean currents

Sciences, University College of Southeast Norway,

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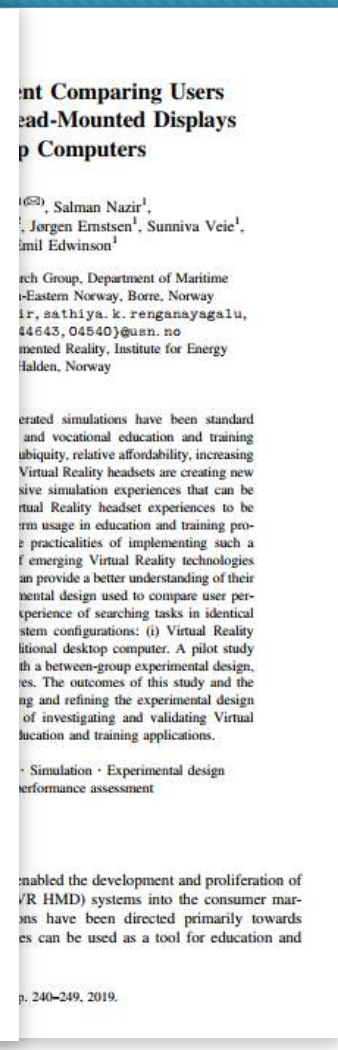

nt Comparing Users
ead-Mounted Displays
p Computers

(✉), Salman Nazir[1],
, Jørgen Ernstsen[1], Sunniva Veie[1],
mil Edwinson[1]

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erated simulations have been standard and vocational education and training ubiquity, relative affordability, increasing Virtual Reality headsets are creating new sive simulation experiences that can be rtual Reality headset experiences to be rm usage in education and training pro-practicalities of implementing such a f emerging Virtual Reality technologies an provide a better understanding of their mental design used to compare user per-xperience of searching tasks in identical stem configurations: (i) Virtual Reality litional desktop computer. A pilot study th a between-group experimental design. es. The outcomes of this study and the ng and refining the experimental design of investigating and validating Virtual ducation and training applications.

· Simulation · Experimental design erformance assessment

enabled the development and proliferation of /R HMD) systems into the consumer mar-ns have been directed primarily towards es can be used as a tool for education and

p. 240–249, 2019.

Springer

# Enhancing human performance in complex socio-technical systems

ENHANCE

University of South-Eastern Norway

UNIVERSITI TEKNOLOGI PETRONAS

WUHAN UNIVERSITY OF TECHNOLOGY
武漢理工大學

KONGSBERG

LIVERPOOL JOHN MOORES UNIVERSITY

RWE
The energy to lead

NATIONAL UNIVERSITY OF SCIENCES & TECHNOLOGY PAKISTAN

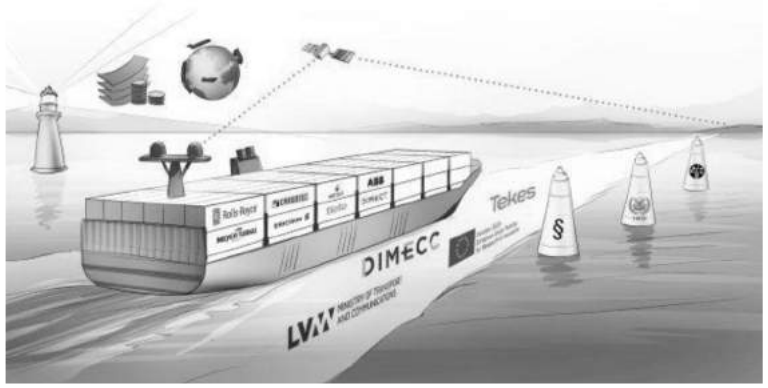
POLITECNICO DI MILANO

RUHR UNIVERSITÄT BOCHUM

RUB

**Budget: 1M EUR**
**Duration: 2019-2023**

# Change in scenario



# Walking into the future

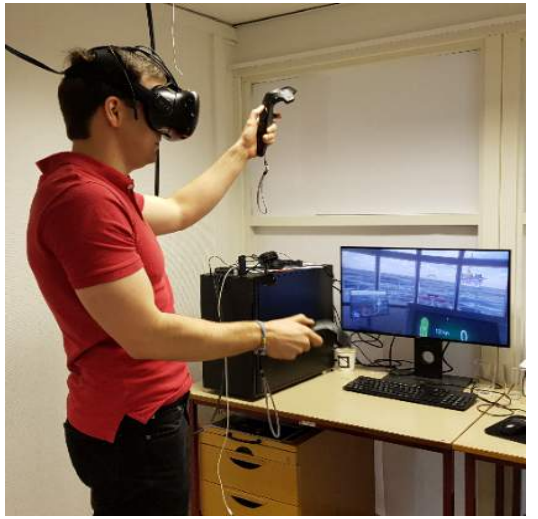
## Challenges in Operator Training for (semi-)Autonomous Systems

# Walking into the future

## Developing an online community of learners for maritime training – A case study

# Walking into the future

**Immersive Virtual Reality in simulator training**



# Walking into the future

**C**ENTRE **O**F EXCELLENCE IN M**A**RITIME **S**IMULATOR **T**RAINING AND ASSESSMENT

**COAST**

Centres for Excellence in Education

Diku

Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education

USN University of South-Eastern Norway

NTNU

THE ARCTIC UNIVERSITY OF NORWAY · UiT ·

Western Norway University of Applied Sciences

MARKOM 2020 DEVELOPS MARITIME COMPETENCE TOWARD

# Walking into the future

Menu

Universitetet i Sørøst-Norge

SHOW STUDY CHOICES

News » News archive » **Fighting for national prestige scheme**

## Fighting for national prestige scheme

IN WORLD CLASS: USN has a professional simulator park in the Research Park on the Vestfold campus.

**USN builds maritime expertise in a digital future. It gets noticed out there. One of our maritime research projects is a finalist in the award for a national prestige scheme.**

TARG

Training and Assessment Research Group

## Centre of excellence in student-centered simulator training on the horizon

Home / Centre of excellence in student-centered simulator training on the horizon

*DIKU and the expert panel together with members of the COAST consortium. Photo: Nils Andreas Kalve*

September 4th, students, teachers, researchers, institutional leaders, alumni and industrial partners were gathered to present their intentions/strategy to become a *Centre of Excellence in Maritime Simulator Training and Assessment* (COAST). Among 7 finalists, a consortium of four institutions: USN, NTNU, UiT and HVL, were invited to discuss their plans with an expert panel and the Norwegian Agency for International Cooperation and Quality Enhancement in Higher

# **I-MERSE:** Interdisciplinary research group for advance effective utilization of imMERSive environments in Education

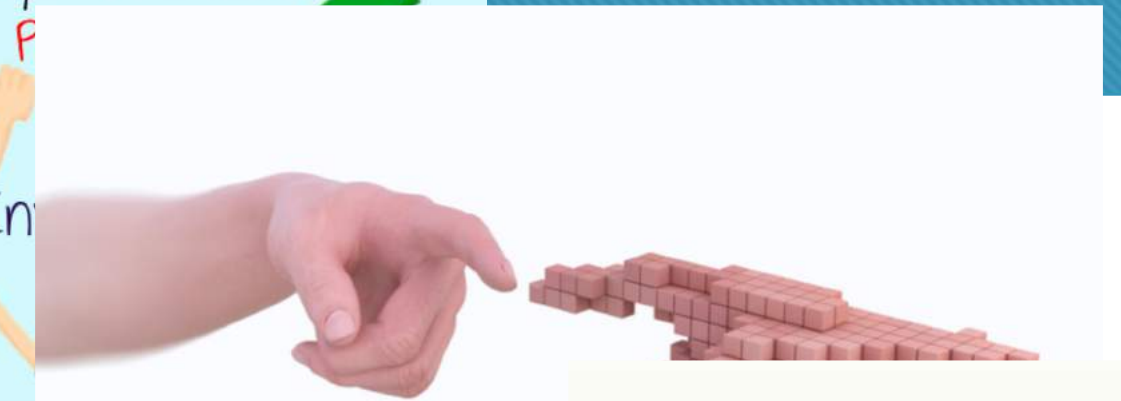
## 4 PhDs announced

**1. Experiential training and learning**
(Faculty of Technology, Natural Sciences and Maritime Sciences)

**2. Visuomotor skills and fostering healthy eye development**
(Faculty of Health and Social Sciences)

**3. Marketing**
(School of Business)

**4. Experiential learning in teacher education**
(Faculty of Humanities, Sports and Educational Science)



Fidelity

# Focus of 9th Workshop

- Emerging versus contemporary technologies and systems
- Emerging technologies and impact on safety
- Trust (and distrust) in technology

+

- Perspectives on Human Error in complex operations
- Safety management models
- Analysis of accidents and accident reporting
- Case studies from maritime, process industries, etc.
- Commonalities and differences between safety practices

=

Insights into new paradigm of operations

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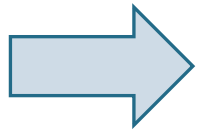
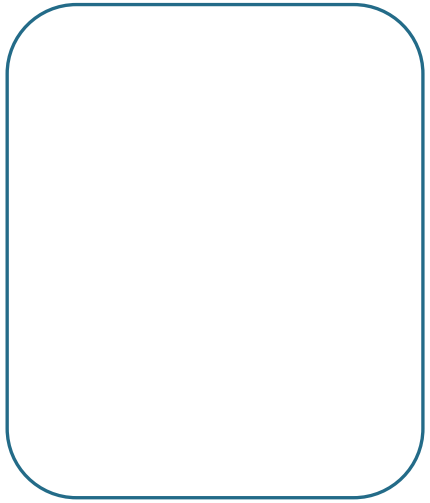


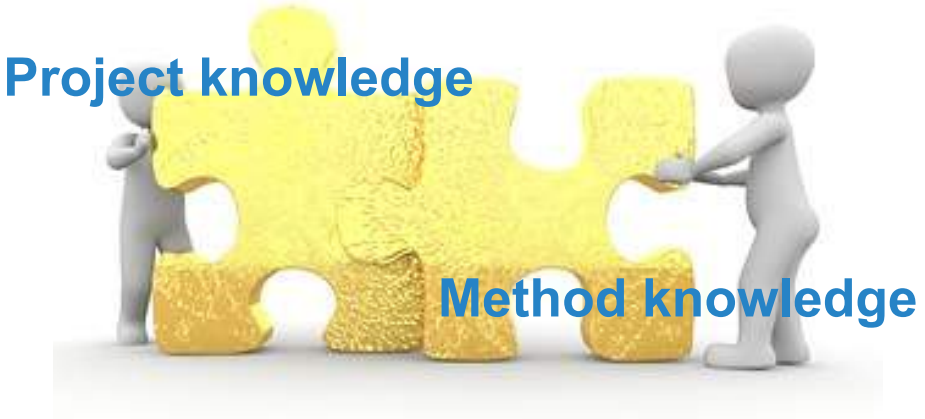


# Looking forward to our next Workshop

- Bringing together both maritime personnel and systems designers: joining the pieces of puzzle related to maritime training & assessment

## 10th Combined Workshop on Training and Assessment (2020)

- Will be based on existing projects, converge the **cutting-edge knowledge** in understanding how to **design training programs** for **digitized and automated future**



# ENHANCE Workshop (8th October)

# Special thanks to…

Ala
Master's student

Hyeran
Master's student

MARKOM2020

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